Maricopa County
Air Quality Department

NON-TITLE V
TECHNICAL SUPPORT DOCUMENT

PERMIT NUMBER:	080073	**App. ID(s):**	401559
BUSINESS NAME:	Arizona Solar One, LLC	**Revision(s):**	0.2.0.0, 1.0.0.0, 1.0.1.0
SOURCE TYPE:	Solar Energy Power Generation Facility	**Revision Type(s):**	Multiple mods and Renewal
PERMIT ENGINEER:	Ralph Munoz	**Date Prepared:**	03/01/2016

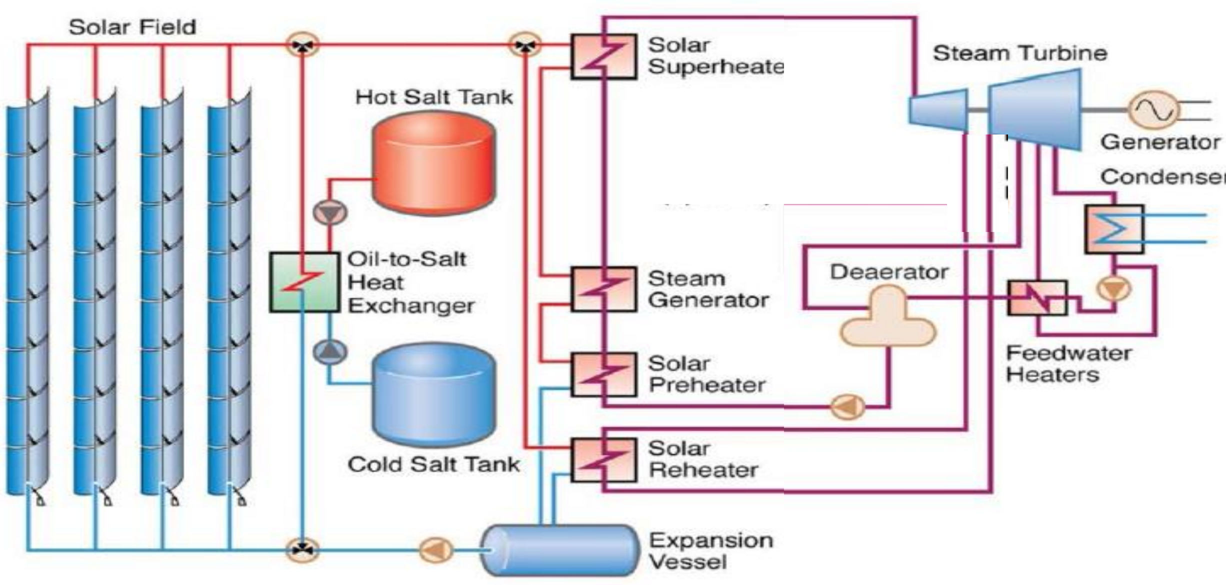
BACT: Yes	**MACT:**	Yes	**NSPS:** Yes	**SYNTH MINOR:** Yes	**AIRS:** No
DUST PLAN REQUIRED:		Yes	**DUST PLAN RECEIVED:** Yes		**1 hr**
O&M PLAN REQUIRED:		Yes	**O&M PLAN RECEIVED:** Yes		**2 hrs**

PROCESS DESCRIPTION:
Arizona Solar One, LLC has built a concentrating solar power (CSP) electrical generating plant, Solana Generating Station (Solana). Solana is a 280-megawatt (MW) gross output (250 Nominal output) electrical generating plant. Solana has two 140-MW steam turbine generators for a nominal output capacity of 250 MW with approximately 30 MW used to operate equipment at the plant. The facility uses parabolic trough technology in which incoming sunlight is reflected from the parabolic mirrors and concentrated onto a recievr tude at the focal point of the parabola. Synthetic heat transfer fluid (HTF) pumped through the receiver tube absorbs solar enegery in the form of water by heat exchangers, thereby onverting the water to steam. The steam is used to drive the turbine generators to produce electricity, which is sent to the power grid. Alternatively, thermal energy storage that would allow the plant to operate when the sky is overcast or for up to 6 non-daylight hours using molten salt technology. The energy depleted HTF is recirculated back through the receiver tubes to collect more solar energy.

The facility is using various pieces of fuel burning equipment for maintenance and/or process related activities.

Arizona Solar One uses storage tanks for molten salt storage as well as other organic/inorganic liquids and also uses cooling towers for process water applications.

Below is a rough process flow diagram of the Arizona Solar One facility:



PERMIT HISTORY:

Date Received	Revision Number	Description
08/01/2008	0.0.0.0	Submitted application for new permit for operation of Solar Power Plant.
02/21/2012	0.1.0.0	Major Modification submitted to address various issues associated with new information regarding emissions, provide refinements and flexibility to previously identified equipment that was to be used.
10/12/12	0.1.1.0	Minor Modification to change emergency generators.
09/18/2013	0.1.2.0	Minor Modification to add a gasoline storage and dispensing operation
03/14/2014	0.1.3.0	Minor Modification to add a temporary diesel fired boiler.
08/26/2014	0.2.0.0	Non-Minor Modification submitted to address emission limit exceedance.
01/15/2015	1.0.0.0	Renewal Application
09/01/2015	1.0.1.0	Minor Mod Application submitted to add bioremediation plant to the process.

PURPOSE FOR APPLICATION:
Arizona Solar one submitted a non-minor modification application to revise the allowable emission limits for the Heat Transfer Fluid (HTF) system on June 27, 2014. Water leaks from the two steam generating trains into the HTF had adversely affected the control efficiency of the Carbon Adsorption System that controls emissions from the Ullage System. Based on Arizona Solar Ones emission calculations, emissions of volatile organic compounds (VOCs) and HAPs had exceeded the allowable emission limits in the existing permit. Since the repairs and removal of the water was anticipated to require an extended time period, ASO submitted a non-minor modification to increase allowable emission limits for VOCs, Single HAP, and total HAPs from the HTF system.

Numerous other changes were revisted with this application to address issues associated with the water leaks at the heat exchangers, such as: VOC And HAP emission characterization/monitoring from the Thermal Storage System Tanks and HTF emissions from Ball Joints.

A. APPLICABLE COUNTY REGULATIONS:

Rule 100: General Provisions and Definitions
Rule 200: Permit Requirements
Rule 220: Non-Title V Permit Provisions
Rule 241: Permits for New Sources and Modifications to Existing Sources
Rule 270: Performance Tests
Rule 280: Fees: Table A: Power Plant with VOC > 25 Tons/year, Source Subject to a BACT determination
Rule 300: Visible Emissions
Rule 310: Fugitive Dust from Dust Generating Activities
Rule 311: Particulate Matter from Process Industries
Rule 323: Fuel Burning Equipment from Industrial/Commercial/Institutional(ICI) Sources
Rule 324: Stationary Internal Combustion Engines
Rule 330: Volatile Organic Compounds
Rule 360: New Source Performance Standards
Rule 370: Federal Hazardous Air Pollutant Program

B. EXISTING APPLICABLE FEDERAL REGULATIONS:

No changes have been made to the applicable federal regulations at the facility with this renewal/modification

40 CFR 60 – Subpart Dc – Standards of performance for small industrial commercial institutional steam generating units. Arizona Solar One is subject to the requirements of NSPS Dc since they operate a propane boiler with a rated capacity of at least 10 MMBtu/hr up to 100 MMBtu/hr. Airzona Solar One chose to use a Rental Boiler with a rated capacity of 100 MMBtu/hr, which is not subject to the additional requirements of NSPS Db.

40 CFR Part 63 NESHAP CCCCCC – Gasoline Dispensing Facilities
Arizona Solar One is subject to the requirements of this NESHAP for storing Gasoline; however, they are well below the 120,000 gallons per year and 10,000 gallons per month thresholds listed in the rule. A limit was placed in the permit to prevent Arizona Solar One from triggering additional requirements from this NESHAP by exceeding these thresholds.

40 CFR 60– Subpart IIII – Standards of performance for Stationary Compression Ignition Internal Combustion engines. Arizona Solar One is using emergency stationary compression ignition internal combustion engines. These engines are manufactured after April 1st 2007; therefore, all engines on site are subject to NSPS IIII. Three engines are being used:

Two 3100 kW emergency engines used as backup power to essential facilities during power failures
One 575 hp emergency fire pump engine.

Each engine is specifically identified in the permit.

40 CFR 63 – Subpart ZZZZ – National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. This standard does apply to the RICE located on Arizona Solar One; however, According to §63.6590(c), the emergency engines or limited use stationary engines that are subject to Subpart IIII (or NSPS subpart JJJJ) are meeting MACT subpart ZZZZ by complying with the standards of NSPS IIII and by doing so, no further requirements under the MACT subpart ZZZZ apply.

C. AIR POLLUTION CONTROL EQUIPMENT/EMISSION CONTROL SYSTEM(s):

System description	Quantity	Comments:
Tri-NOx Multichem NOx Wet Scrubber System	1	O&M plan not submitted with application. Scrubber system used to control NOx emissions associated with melting the salt in the salt tanks.
Heat Transfer Fluid Scrubbers	2	O&M plan not submitted with application. Ullage gases vented from the Heat Transfer Fluid expansion vessels, comprised of nitrogen, HTF, and degredation products will be routed to this Scrubber.
Carbon Adsorption Unit	1	O&M plan needs to be resubmitted as a result of this permit modification. Vapors from the condensate receiver vessel will be sent to the packed srubber and the remaining gases will be vented to the carbon adsorption unit.
Condensate Reciever Vessel	1	O&M plan approved. Vapors from the HTF expansion vessels (comprised of nitrogen, HTF, and degradation byproducts) will be sent to the condensate receiver vessel.
Drift Eliminators – Cooling Towers		No O&M plan required.

See process flow diagram attached in the appendix for each air pollution control device described above.

D. EMISSIONS:

1. **HTF System Emissions:**

VOC and HAP emissions from the venting of the HTF expansion vessels and the overflow tanks wil be controlled by a system of heat exchangers and wet scrubbers to recover HTF, followed by a carbon adsorption system (Ullage Cleaning System). Flow rates and chemical composition of the outlet steams from the HTF recovery system were obtained from engineering simulations software used to design the HTF system, assuming worst-case degredation by-product concentrations in the HTF system.

Emissions from the HTF venting process exiting the carbon adsorption system were calculated using maximum design volumetric flow rates for the expansion vessels and Overflow tanks and assuming a maximum VOC outlet concentration of 243 ppm measured as benzene. This maximum VOC outlet concentration is based on the definition of "breakthrough" in the most recent approved O&M plan.

HAP emissions were calculated based off the most recent ASPEN engineering simulation (found in the Permit application). ASPEN simulation was based on worst degradation HAP byproduct concentrations estimated using HTF thermal degradation data obtained from Solutia, the HTF manufacturer.

The Individual HAP compositions used in PTE calculations for the HTF ullage system are summarized below:

Table B.4.1 Individual HAP Compositions for Emissions from the HTF Ullage System (% of VOC Emissions)

Constituent	2012 Non-Minor Permit Revision Application		Amended PTE Calculations
	Carbon Adsorption System Inlet Stream from Expansion Vessels	Carbon Adsorption System Inlet Stream from Overflow Tanks	Carbon Adsorption System Outlet Stream
Biphenyl	0.3761	0.3236	0.3641
Benzene	94.62	94.64	94.63
Toluene	3.297	3.514	3.376
Phenol	0.6170	0.5974	0.6103
High Boilers	0.04113	0.03394	0.03829

2. **NOx emissions from the TES System:**

Maximum NOx emissions from the thermal decomposition of the Magnesium nitrate ($Mg(NO_3)_2$) impurities in the salt used in the TES system was based on the amount of salt in the TES system (approximately 138,900 tons), the maximum percentage of magnesium impurities in the salt of 0.08% by weight guaranteed by the vendor, the chemical reaction for the thermal decomposition of $Mg(NO_3)_2$, and the rate of reaction for the thermal decomposition of magnesium nitrate as predicted by research conducted at the University of Barcelona. The chemical reaction for the thermal decomposition of $Mg(NO_3)_2$ is:

$$Mg(NO_3)_2 \rightarrow MgO + NO_2 + NO + O_2$$

Based on the amount of salt and the concentration of $Mg(NO_3)_2$ in the salt, it is estimated that approximately 350 tons of NOx will be produced from the heating and melting of the salt (based upon the thermal degradation of 111.12 tons of magnesium impurities)

Maximum hourly and daily NOx emisisons are calculated using data generated form the research conducted at the University of Barcelona. Tests performed at the University were open to the atmosphere, providing ideal conditions for the thermal decomposition of $Mg(NO_3)_2$. The melting of salt and subsequent storage of molten salt will occur in enclosed tanks; consequently, the rate of reaction under actual operating conditions will be slower than the rates measured during lab tests. Based on degredation curves for the thermal decomposition reaction at 300 degrees C and 385 degrees C, the following rate equations for decomposition of $Mg(NO_3)_2$ were derived:

$$\% Mg(NO_3)_2 = 86.634e - 0.0137 * t(hrs) \quad \text{at } 300^oC$$

$$\% Mg(NO_3)_2 = 91.157e - 0.023 * t(hrs) \quad \text{at } 385^oC$$

Based on the rate of reaction equations, maximum uncontrolled hourly and daily NOx emissions during the melting of salt were estimated to be approximately 229.5 lbs/hr and 5,510 lbs/day, as the salt is fed to the melting furnace at a rate of 1,000 metric tons/day (1,102 short tons/day). Maximum uncontrolled hourly and daily NOx emissions during operation of the TES system (following the melting/commissioning of the salt), were estimated to be approximately 1,375 lbs/hr and 8,250 lbs/day.

Since originally melting the salt, it is assumed most of the NOx has been released from the salt and the NOx scrubber has been removed from the TES tanks. Annual emissions from the salt tanks were calculated based off the original limitation placed in the permit of 100 lbs per day and 365 days per year of operation = 18.25 Tons/year of NOx.

3. Equipment Leaks: (HTF system)

VOC emissions from the HTF system components were calculated using emission factors obtained from Kern County Air Pollution Control District (APCD) Determination of Compliance engineering Evaluation for Beacon Solar power plant. The Beacon Solar Power plant proposed to use the same HTF, Solutia Therminol VP-1. Emission factors are given below:

Equipment Type		Emission Factor
		VOC (lbs/hr/source)
Valves		0.00025169
Pump Seals		0.0008448
Connectors		0.0000165
Pressure Relief Valves		0.09854

Annual VOC emissions are calculated by multiplying the emission factors by the number of sources/units in the HTF system (8,321 valves, 50 pump seals, 1,968 connectors, and 10 pressure relief valves) and assuming continuous contact of the HTF with the components in the system (8760 hrs/year). Daily and annual VOC emissions are calculated by multiplying the emission factors by the number of units and assuming continuous contact of the HTF with the components in system (24 hrs/day and 8760 hrs/year). Although only various portions of the system are pressurized for a portion of the day, emission calculations represent worst-case scenario.

The PTE of HAPs were calculated using individual HAP compositions (Ppercentage of total VOC) of the outlet stream from the expansion vessels, which was obtained from the most recent ASPEN engineering simulation.

ASPEN simulation was based on the worst case degredation HAP byproduct concentrations estimated using HTF thermal degredation data obtrained from Solutia, the HTF manufacturer.

Table B.4.2 Individual HAP Compositions for Emissions from HTF System Components (% of VOC Emissions)

Constituent	2012 Non-Minor Permit Revision Application	Amended PTE Calculations
Biphenyl	22.32	20.747
Benzene	7.936	12.695
Toluene	0.7727	1.324
Phenol	5.495	6.349
High Boilers	3.221	2.789

4. Equipment Leaks: (TES system)

Leaks of HTF will also occur within the TES system heat exchangers during charging and discharging of the thermal energy. These leaks are transmitted by the salt to the TES salt tanks and vented from the tanks. VOC and HAP emissions due to leaks within the heat exhangers were calculated using a leak rate of 1.0 x 10-7 (dimensionless) obtained by the manufacturer Alfa Laval. The leak rate specified for the heat exchangers by the venter was based on the sensitivity of the measuring device used and provides a very conservative leak rate for the equipment.

Maximum annual VOC emissions are calculated by multiplying the flow rate of HTF within the heat exhangers (60,500 gallons per min, 3,630,000 gallons per hour) by the average density of the HTF (6.47 lbs/gal), the manufacturer's leak rate, and the charging and discharging time (12 hours/day, and 4,380 hours/year).

Individual HAP emissions are subsequently calculated by multiplying the total fugitive VOC emissions by the individual HAP composition of the outlet streatm from the systems, obtained from ASPEN engineering simulation based on worst-case degredation HAP byproduct concentrations.

5. HTF System Ball Joints:

Annual process rates for leaks from the HTF System Ball Joints are based on the Leak Detection and Repair Plan (LDAR) goal of a maximum overall leakage rate of 5.00% for the entire solar field. Based on the overall LDAR goal, the percentage of heavy, medium, and slightly leakers are broken down as follows: 0.29% heavy leakers, 1.29% medium leakers, and 3.42% slight leakers at any given time. There are 16,160 small ball joints in the solar field, and based on the LDAR goals, the maximum number of heavy, medium, and slight leakers at any given time is 46.6, 209, and 552.8, respectively. Annual process rates for leaks from the HTF System Ball Joints are calculated based on 8,760 hours/year.

Emissions from the HTF System Ball Joints are calculated based on the results of performance testing conducted in May 2015. A total of 8 Ball Joints were tested (4 ball joints considered to beheavy leakers and 4 ball joints considered to be medium leakers). Due to interference of methylenechloride (likely due to field decontamination of the testing equipment), the results for one of theball joints (085-J-001) were not used in the calculation of emission rates for the ball joints.

Measure emission rates for the heavy leakers (076-O-019, 012-N-020, and 084-J-019) were averaged to obtain an emission rate for heavy leakers on a lb/hr per unit basis (0.0071 lb/hr/ball joint). Similarly, measure emission rates for the medium leakers (001-M-008, 021-J-004, 068-O-017,and 083-L-007) were averaged to obtain an emission rate for medium leakers on a lb/hr per unitbasis (0.0053 lb/hr/ball joint). An emission rate for slight leakers was assumed to be 50% of theemission rate for medium leakers (0.0027 lb/hr/ball joint).In averaging the results for the heavy and medium leakers, if the sum of the measured emissionrates for detected HAPs was greater than the measured emission rate for VOCs, than theemission rate for total detected HAPs was used.

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HAP emission rates for heavy, medium, and slight leakers were based on the results of performance testing as shown below:

Table B.4.3 HAP Emission Factors for Ball Joints

Table B.4.3 HAP Emission Factors for Ball Joints

CAS No.	Compound	Average Heavy Leak Rate (lbs / hour / ball joint)	Average Medium Leak Rate (lbs / hour / ball joint)	Average Slight Leak Rate (lbs / hour / ball joint)
74-87-3	Chloromethane	3.6E-09	0.0E+00	0.0E+00
107-02-8	Acrolein	4.7E-08	0.0E+00	0.0E+00
75-09-2	Methylene Chloride	1.8E-05	5.7E-05	2.8E-05
110-54-3	n-Hexane	1.8E-07	9.6E-09	4.8E-09
71-43-2	Benzene	5.7E-06	1.3E-07	6.7E-08
123-91-1	1,4-Dioxane	3.0E-09	0.0E+00	0.0E+00
80-62-6	Methyl Methacrylate	7.3E-08	0.0E+00	0.0E+00
108-88-3	Toluene	3.3E-07	3.2E-08	1.6E-08
100-41-4	Ethylbenzene	1.0E-07	1.6E-07	7.8E-08
179601-23-1	m,p-Xylenes	5.9E-07	3.9E-07	1.9E-07
95-47-6	o-Xylene	1.6E-07	8.8E-08	4.4E-08
92-52-4	Biphenyl	7.0E-03	9.0E-04	4.5E-04
108-95-2	Phenol	3.8E-05	2.9E-06	1.5E-06
	HAP Totals	**7.06E-03**	**9.57E-04**	**4.79E-04**

Performance Testing results for the ball joints are presented in Appendix C of the permit application.

6. HTF Heater:

Arizona Solar One currently has a 100 MMBtu/hr rental Boiler on site.

The boiler specifications submitted with the application indicate an emission rate of 0.036 lb of NOx/MMbtu. Emission limits were calculated using the manufacturer's value of 0.036 lbs of NOx / MMBtu when burning Natural gas.

The facility plans on burning Propane instead, which has an estimate emissions rate of 35 ppmv at 3% O2, which is 5 ppmv more than the natural gas emissions of 30 ppmv at 3% O2. To account for this the following emission factor was used:

$$30\text{ppmv} \rightarrow 35\text{ ppmv} = 16.8\%\text{ difference}$$
$$0.036 * 1.168 = \mathbf{0.0420\ lbs\ of\ NOx\ /\ MMbtu}$$

This emission factor will be verified at the time the facility conducts performance tests.

The rest of the emission factors (PM, PM10, PM2.5, CO, Sox, and VOC) were taken from AP-42 chapter 1.5 liquified petroleum gas combustion (07/08), table 1.5-1. The emission factors are converted from units of lb/10^3 gallons to unit of lb/MMBtu by assuming a propane heating value of 91.5 MMBtu/10^3 gal (From AP-42, Section 1.5.3.1). The emission factor total organic compounds (TOC) was used to calculate the emissions of volatile oraganic compounds (VOC). Since PM emissions are a result of fuel combustion, all PM is assumed to be equal to PM2.5, which represents a likely worst-case scenario for emissions of PM.

7. Cooling Towers:

The cooling towers cool water from the condenser used to condense exhaust from the steam generator. During the heat exchange process, small droplets are released to the atmosphere as "drift". The only air pollutant from the cooling tower is PM, which is generated from dissolved solids in the water crystallizing when the drift droplets evaporate. The cooling tower will use a drift eliminator to maintain drift losses at less than 0.0005% of circulating water flow.

According to AP-42 chapter 13.4, Wet Cooling Towers (1/95), part 2:
A conservatively high PM10 emission factor can be obtained by multiplying the drift loss by the TDS fraction in the circulating water and by assuming that, once the water evaporates, all remaining solid particles are within the PM10 size range.

It was assumed that the maximum amount of Total Dissolved Solids in the water was equal to the maximum allowable TDS of the waste water treatment facility that the site will get its water from. (20,000 ppm TDS):

Emission factor=
(0.0005 lb Drift/100 lb water) * (20000 lb solid/1000000 lb Drift) = **1 x 10-7 lbs solid/ lb water**

Emissions rate = (emission factor) (volumetric flow rate) (conversion factor)(density of Water)
Emissions rate = (1 x 10-7 lbs solid/ lb water) (180000 gal/min)(60min/hr)(8.4 lb/gal)
Emissions rate = 9.072 lbs/hr of PM10 per tower

Daily Emissions = 9.072 lbs/hr x 20 hrs/day = 181.4 lbs/day of PM10 per tower
Annual Emissions = 9.072 lbs/hr x 7,300 hrs/year = 66226 lbs/year of PM10 per tower

8. Emergency Generators:

Stand-by Emergency Generators-
The facility is using two standby emergency generators each rated at 3100 kW or 4376 hp. Emissions from these generator were calculated using the applicable emission standards of 40 CFR 89.112 for engines above 550 kW(750 hp). The generators were calculated to run a total of 500 hours per year (daily emissions were not calculated since BACT limits are exempt for emergency generators.)

SOx emission data was not present within the MSDS sheet supplied with the application, therefore, AP-42 emission data was used from Chapter. 3.4 Large stationary Diesel and All Stationary Duel Fuel engines (10/96).

Sulfur dioxide emissions are calculated by performing a mass balance with the sulfur content of the diesel fuel. The content of the sulfur in the diesel fuel is 15 ppm, and the sulfur oxide emission factor is calculated as follows:

Density of Fuel * Concentration of S * Ratio of SO2 Output to S Input = Emission Factor

7.11 [lb fuel/gal fuel] * 15/1000000 [lb S/lb Fuel] * 64/32 [lb SO2/lb S] = **0.0002136 lbs SO2/gal**
This emission factor is multiplied by the maximum hourly, daily, and annual fuel use rate to estimate emissions.

The potential to emit of HAPs were calculated by using the emission factors from AP-42, table 3.4-3 and 3.4-4. The Emission factors are given in units of pounds per MMBtu of fuel input. The emission rates are calculated by using the equation below, using the fuel use rate specified by the manufacturer and assuming average values of 7000 btu fuel input/hp-hr power output and a diesel energy density of 19,300 btu/lb:

Fuel Use Rate[Gal/hr] * Heating Value of Diesel [MMBtu/gal] * EF[lb/MMBtu] = Emissions Rate

Maximum annual HAP emissions are calculated by multiplying the emission rate by the maximum hours of operation for both generators (24 hours/day, 500 hours/year).

<u>Fire Pump-</u>
The Clark Fire Pump includes a Tier 3 Certified John Deere 575 hp diesel-fired engine. The Fire Pump is only expected to be used up to 1 hour/week to a maximum of 50 hours/year for testing. Predicted emissons do not reflect any expected emergency operation. For purposes of calculating PTE, maximum daily and yearly operating hours were assumed to be 24 hours/day and 500 hours/year. The procedures for calculating the emisisons of the Fire Pump are shown below:

NOx, CO, PM and VOC emission rates are provided by the manufacturer. The manufacturer's specifications were provided with the application and are shown here:

Pollutant		Emission Factor
		Rate (g/hp-hr)
NOX		2.8
CO		2.6
PM, PM10, PM2.5		0.09
HC, VOC		0.2

Maximum hourly, daily, and annual emissions are calculated by multiplying the emission factors by the maximum capacity of the engine and the maximum hours of operation (24 hours/day, and 500 hours/year.)

SO2 and HAP emission rates were not reported by the manufacturers and were calculated using data from AP-42, Section 3.3 Gasoline and Diesel Industrial Engines (10/96). Emission factors given in Section 3.3 of AP-42 are for calculating emissions from gasoline and diesel engines rated up to 600 hp.

The PTE of HAPs are calculated by using the emission factors from AP-42, table 3.3-2. The emission factors are given in units of pounds per MMBtu of fuel input. The emission rates and maximum emissions are calculated in the same manner as the emergency generators (Stand-by Emergency Generators above.)

FACILITY WIDE ALLOWABLE EMISSIONS

Pollutants	**Facility wide Annual Emissions**
CO:	50,240 lbs
NOx:	78,620 lbs
PM10:	68,522 lbs
PM2.5:	68,522 lbs
VOC:	82,400 lbs
SOx:	104 lbs
Total HAPs	37,809 lbs

Any Single HAP	
Benzene	16,484 lbs
Biphenyl	15,740 lbs
Toluene	932 lbs
Phenol	2508 lbs
Dibenzofuran	1,062 lbs

E. HAP EMISSION IMPACTS:

Arizona Solar One is estimated to be emitting 7.87 tons of Biphenyl from their HTF system. Other HAP emissions include Benzene at 8.24 tons and 1.25 tons of Phenol. The acute and chronic thresholds for Biphenyl are much lower than Benzene, so only Biphenyl was modeled below

A screen model was done to check if the concentration levels are below standards outlined in MCAQD modeling guidelines:

The 24-hour (C_{24}) and annual (C_{annual}) concentrations were calculated based on the modeled maximum 1-hour concentration (C1).

C_{24} = C1 x 0.4
C_{annual} = C1 x 0.08

The modeling exercise shows that the acute ambient air concentrations max out at 6.379 mg/m3(C1). The acute concentration standard is 38 mg/m3 for biphenyl. The facility's hourly emissions are currently showing lower than the standard.

The 24 hour calculated value is 6.379 x 0.4 = 2.55 mg/m3
The annual is C_{annual} = 6.379 x 0.08 = 0.51032 mg/m3

The chronic/annual standard is 0.183 mg/m3. Therefore, this model does show Arizona Solar One having the potential to exceed the chronic threshold for Biphenyl. The source has been notified of this exceedance.

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 *****************************  STACK PARAMETERS  ***************************
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 SOURCE EMISSION RATE:            0.2368 g/s                  1.879 lb/hr
 STACK HEIGHT:                      1.52 meters                4.99 feet
 STACK INNER DIAMETER:             0.305 meters               12.00 inches
 PLUME EXIT TEMPERATURE:          Ambient
 PLUME EXIT VELOCITY:             15.240 m/s                  50.00 ft/s
 STACK AIR FLOW RATE:               2356 ACFM
 RURAL OR URBAN:                  RURAL

 INITIAL PROBE DISTANCE =          1000. meters               3281. feet


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 **********************  BUILDING DOWNWASH PARAMETERS  **********************
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         NO BUILDING DOWNWASH HAS BEEN REQUESTED FOR THIS ANALYSIS


 *************************  PROBE ANALYSIS  **************************
                 25 meter receptor spacing: 25. meters - 1000. meters


      Zo       ROUGHNESS        1-HR CONC    DIST       TEMPORAL
      SECTOR     LENGTH          (ug/m3)      (m)        PERIOD
      ------------------------------------------------------------------
       1*         0.001         6289.        50.0       WIN
 * = worst case flow sector



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 *********************  MAKEMET METEOROLOGY PARAMETERS  ***************
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 MIN/MAX TEMPERATURE:    250.0 / 310.0 (K)

 MINIMUM WIND SPEED:       0.5 m/s

 ANEMOMETER HEIGHT:     10.000 meters

 SURFACE CHARACTERISTICS INPUT: AERMET SEASONAL TABLES

 DOMINANT SURFACE PROFILE: Water
 DOMINANT CLIMATE TYPE:    Average Moisture
 DOMINANT SEASON:          Winter

 ALBEDO:                  0.20
 BOWEN RATIO:             1.50
 ROUGHNESS LENGTH:       0.001 (meters)


        METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT
        -------------------------------------------------------------

  YR MO DY JDY HR
  -- -- -- --- --
  10 03 02   2 01

     H0     U*     W*  DT/DZ ZICNV ZIMCH  M-O LEN    Z0  BOWEN ALBEDO  REF WS
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  -0.17  0.032 -9.000  0.020 -999.   13.     14.5 0.001   1.50   0.20    1.00

     HT  REF TA     HT
 - - - - - - - - - - -
   10.0   250.0    2.0

 ESTIMATED FINAL PLUME HEIGHT (non-downwash):     22.6 meters


        METEOROLOGY CONDITIONS USED TO PREDICT AMBIENT BOUNDARY IMPACT
        --------------------------------------------------------------

  YR MO DY JDY HR
  -- -- -- --- --
  10 04 07   2 01

     H0     U*     W*  DT/DZ ZICNV ZIMCH  M-O LEN    Z0  BOWEN ALBEDO  REF WS
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  -0.31  0.059 -9.000  0.020 -999.   33.     50.2 0.001   1.50   0.20    1.50

     HT  REF TA     HT
 - - - - - - - - - - -
   10.0   250.0    2.0
```

```
ESTIMATED FINAL PLUME HEIGHT (non-downwash):     13.6 meters


----------------------------------------------------------------------------
*********************** AERSCREEN AUTOMATED DISTANCES *********************
                 OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE
----------------------------------------------------------------------------


                      MAXIMUM                             MAXIMUM
             DIST    1-HR CONC                   DIST    1-HR CONC
              (m)     (ug/m3)                     (m)     (ug/m3)
           ---------------------               ---------------------
             25.00     5762.                     525.00     1528.
             50.00     6289.                     550.00     1472.
             75.00     5053.                     575.00     1419.
            100.00     4419.                     600.00     1368.
            125.00     4007.                     625.00     1319.
            150.00     3574.                     650.00     1273.
            175.00     3196.                     675.00     1229.
            200.00     2860.                     700.00     1188.
            225.00     2686.                     725.00     1148.
            250.00     2551.                     750.00     1110.
            275.00     2410.                     775.00     1074.
            300.00     2272.                     800.00     1040.
            325.00     2149.                     825.00     1008.
            350.00     2038.                     850.00     977.2
            375.00     1948.                     875.00     947.8
            400.00     1862.                     900.00     919.8
            425.00     1784.                     925.00     893.1
            450.00     1708.                     950.00     867.7
            475.00     1646.                     975.00     843.4
            500.00     1586.                    1000.00     820.2


----------------------------------------------------------------------------
*********************  AERSCREEN MAXIMUM IMPACT SUMMARY  ********************
----------------------------------------------------------------------------

                         MAXIMUM      SCALED      SCALED      SCALED      SCALED
                          1-HOUR      3-HOUR      8-HOUR     24-HOUR      ANNUAL
  CALCULATION              CONC        CONC        CONC        CONC        CONC
   PROCEDURE             (ug/m3)     (ug/m3)     (ug/m3)     (ug/m3)     (ug/m3)
----------------     ----------  ----------  ----------  ----------  ----------
FLAT TERRAIN           6379.       6379.       5741.       3827.       637.9

DISTANCE FROM SOURCE         45.00 meters



IMPACT AT THE
AMBIENT BOUNDARY       5762.       5762.       5186.       3457.       576.2

DISTANCE FROM SOURCE         25.00 meters
```

F. PERFORMANCE TESTING:

Performance testing was conducted on the Ball joints to determine an emission characterization for each type of ball joint identified in the LDAR. The test methods used to determine the emission rate for each type of ball joint was not representative of actual emissions since testing results did not include some of the condensation that occurred on the testing apparatus. As a result, this permit modification is seeking to establish new representative emission characterizations of the ball joints.

Emissions Characterization Requirements: The Permittee shall conduct an emission characterization on the following equipment as specified:

Ball Joint leak information – Testing shall occur within 60 days after this permit issuance date (1.1.0.0). The testing deadline may be extended by the Control Officer for good cause, but in no case shall the testing deadline, including test report submittal, extend beyond 180 days after the applicable date:

1) The Permittee shall conduct a minimum of three tests for each type of ball joint identified below for HAP and VOC emissions, selected in the test protocol for approval by the Department.

   The ball joints shall consist of "low" or Grade 3 leaks, "medium" or Grade 2 leaks and "non-visible" or Grade 4 leaks (as defined in the LDAR).

2) The Permittee may choose to use the highest result of the 3 tests as representative of emissions.
   - If the Permittee does not wish to use the highest test result, then they may conduct further tests until a statistically valid result is achieved and use the average of all tests. Statistically valid shall be defined as a coefficient of variation < 25%.
   - The coefficient of variation shall be calculated for the data from the tests:

     The coefficient of variation (c_v) = (standard deviation) / (mean)

$$c_v = \frac{\sigma}{\mu}$$

   - If the coefficient of variation is > 25%, additional tests shall be performed until the coefficient of variation falls below 25%.

This coefficient of variation will help make sure the source gets accurate data for characterizing ball joint types. If there are huge differences between "similar" types of ball joints, then the source will need to use worst case scenario emission characterization data. Repeat testing is not currently required, as long as the first test shows representative data. If there is insufficienct data for purposes of monitoring emissions, the Department reserves the right to ask for repeat testing.

Testing will be identified in the procotol submittal rather than the permit to allow for flexibility within the testing methodology.

G. REGULATORY REQUIREMENTS AND MONITORING:

-The permit modification submitted by Arizona Solar one were a result of violations received over the last two years. Arizona Solar One was asked to submit a compliance plan which outlined all the causes and effects of any and all malfunctions which may have cause the violations to the existing air permit. This compliance plan was used to set new operational requirements to ensure violations are caught in a timely manner. Major changes to existing permit conditions are outlined below:

Permit Condition 1

-NOx emission limits were changed from Daily to Annual. Daily limits are no longer supported by Rule 241 with the changes to the rule which occurred in Feb 2016.

Permit Condition 4

-Updated the Ullage system language to account for the overflow cooler being equipped with an appropriate subgrade tank where liquids from the cooler are collected for separation and disposal.

-The Carbon Adsorption system breakthrough was placed in the permit at 110 ppm instead of allowing breakthrough to be defined in the O&M plan.

-required changeout to occur within 24 hours of breakthrough being triggered, rather than 5 days (which was previously allowed in the O&M plan).

Permit Condition 5
-Vent lines between the TES hot and cold storage tanks need to be increased in size to allow for adequate pressure increases that cause the pressure relief valves to open – emitting some HTF to the atmosphere. Tanks not currently operating do not need to have this increase in vent line done until they are brought back into operation.

Permit Condition 6
-Added an O&M plan requirement for the TES vent line/condensate system

Permit Condition 8
-added specific language for Ball Joint testing (explained above in the testing section).
-removed NOx testing from the TES storage tanks as the salt has had adequate time to release NOx.

Permit Condition 9
Added a comprehensive Leak Detection and Repair plan to the permit. This condition specifies exact requirements that need to be included in the LDAR.
-Added language to monitor VOC emissions from any bio remediation that occurs (if applicable).

Permit Condition 10
-added recordkeeping requirements to the permit for HTF fluid to get an accurate material balance on any and all HTF releases.

Permit Condition 11
-added semi-annual reporting requirements to the permit.
-HTF contamination reporting added.

-BACT Rule 241
The rental boiler was originally evaluated as being "temporary" in the first BACT analysis submitted by the facility. As a result, the NOx standard was allowed to be higher than normal as long as the source removed the Boiler from the site after a year. This modification seeks to keep the Rental boiler on site and has taken a limit of 8,760 hours for the lifetime of the permit. This limit let the source keep the higher NOx standard of 35 ppmv @ 3% oxygen.

The threshold values for annual VOCs in Rule 241 were exceeded with this permit modification. The Facility decided to use our BACT policy which allows the use of a California agency BACT in place of a top down BACT analysis, attached is the analysis submitted by Arizona Solar One:

Valves, Pump Seals, Flanges / Connectors, Pressure Relief Valves
The Non-Minor Permit Revision Application submitted in February 2012 in order to update the permit to reflect the new information and the subsequent changes to the original design of the Solana facility, included the identification of numerous valves, pump seals, flanges/connectors, and pressure relief valves, which were not quantified in the originally application. Such equipment is subject to leaks.

Leaks from various HTF components (e.g., valves, pump seals, connectors, and pressure relief valves) represent fugitive emissions and cannot be reasonably captured and vented through a stack or control device. Therefore, BACT for these emissions is good operating and maintenance practices and procedures.

TES System

Previous equipment issues allowed HTF to enter into the TES salt tanks. Repairs have been made to address these issues; however, the residual HTF in the salt vapors into the tanks' headspace and expands into the tanks' vent lines during salt discharge (typically occurring in the evening each day for approximately 2 to 6 hours at each unit). The gases vented from the TES salt tanks are comprised almost entirely of nitrogen that blankets the headspace of the tanks, minimal concentrations of residual HTF, and any NO_X generated by any remaining $Mg(NO_3)_2$ impurities. (Refer to the June 4, 2015, TES Report prepared by Stantec for analytical results on TES 3 and 6 emissions.) The HTF emissions due to leaks within the TES heat exchangers are small and represent a minute fraction of the gases, save the event recently occurring at TES 3 which has been reported to MCAQD separately and included in Response (4). Further treatment of these gases to reduce HTF emissions is not feasible, and BACT for HTF emissions due to leaks within the heat exchangers is good operating and maintenance practices and procedures. In addition, temporary vent lines will be replaced with larger diameter vent lines to prevent discharge of emissions at the TES tanks. The larger vent lines will be of sufficient capacity to contain the volume of expanded gases during salt discharge. HTF is not anticipated to be vented from TES once this modification is in place. Any residual (or potential new leaks) of HTF into TES will be condensed in the vent lines and collected in the associated drums.

Ball Joints

Since submittal and issuance of the 2012 Non-Minor Permit Revision, ball joints located between the collectors in the solar field were identified as an additional source of fugitive emissions. There are a total of 16,160 ball joints between the horizontal pipelines in the solar collector loops. The ball joints allow for movement of the solar collectors to track the sun throughout the day. Ball joints are comprised of a stainless steel material with graphite packing present inside each ball joint. The joints are engineered to allow for both the thermal expansion of the collector tubes and rotation of the mirror concentrators in order to track the sun's movement during operation.

Ball joint leakage is a function of packing, temperature, and movement. At higher temperatures, the graphite and natural thermal expansion of the metal causes the packing in the ball joint to expand and seal, at which point fugitive emissions are at their lowest or nonexistent. Slight leaks may begin after sunset, when the HTF within the solar loop begins to cool and the piping and components begin to contract. Greater leaks may begin in the early morning prior to sunrise, when the HTF within the solar field is at its coolest temperature and pressure within the piping is increased for operational circulation of the HTF for the daily startup of the plant. Because leaks are affected by temperature, pressure, and movement of the mirrors as they track the sun, most leaks are intermittent.

As with other HTF components, leaks from the ball joints represent fugitive emissions and cannot be reasonably captured and vented through a stack or control device. Therefore, BACT for these fugitive emissions is good operating and maintenance practices and procedures. As part of its commitment to appropriate and timely maintenance, ASO prepared and submitted a Leak Detection and Repair Plan (LDAR) to MCAQD.

As part of the LDAR Plan, solar collectors, joints, and connection points are regularly inspected as part of the Solar Field Operator's normal daily tasks. All parts of the solar field are observed on a daily basis between the hours of 07:00 and 18:00 to ensure efficient plant operation and to identify maintenance or repair issues that might arise during the course of operations.

Repair or replacement, as appropriate, may include the repacking of the graphite material within the ball joint or complete replacement of the ball joint. If the appropriate solution is determined to be repair of the ball joint, this will be accomplished by repacking of the graphite material within the ball joint to reestablish the joint seal.

NON-TITLE V
COMPLETENESS DETERMINATION CHECKLIST

Items 1-15 Front page: Items 1 to 15 (14 for Renewals) must be completed.

Notes to engineer:

- *For renewal applications the source must either answer 'No' to questions 2-5 or submit an application for a permit modification.*
- *Item 8: Many applicants do not know the SIC code or NAICS code for their industry. For a new application the code can be obtained by doing an on-line search. http://www.osha.gov/pls/imis/sicsearch.html*
- *Items 5, 7 and 14: These may be the same for many applicants.*

Complete: x Incomplete: ☐

Item 16: A simple site diagram has been included, preferably on a standard size paper. Detailed blueprints or construction drawings are not required.

Complete: x Incomplete: ☐ N/A: ☐

Item 17: A simple process flow diagram on a standard size paper is preferred. A process flow diagram may not be needed for some small businesses.

Complete: x Incomplete: ☐ N/A: ☐

Item 18: An O&M plan is required only for a control device. An O&M plan is not required for a spray booth. Instead of including the O&M plan with the application, an applicant may submit it after receiving the permit.

Complete: ☐ Incomplete: ☐ N/A: x

Item 19: A dust control plan, if required, must accompany the permit application. The plan will be reviewed and approved by the dust compliance group.

Complete: ☐ Incomplete: ☐ N/A: x

Item 20: The applicant needs to complete only those sections of the permit application that are applicable.

Complete: x Incomplete: ☐ N/A: ☐

Notes to engineer:

- *Concerning Section Z: Many applicants will not be able to perform these engineering calculations. We will accept the permit application with a blank Section Z.*

Instructions for completing Sections A, B, C, D, E-1, E-2, F, G, H, I, J, K-1, K-2, K-3, K-4, L, M, X-1, X-2, Y and Z of the permit application are included at the beginning of each section and are self-explanatory.

In general, a material safety data sheet (MSDS) is required for each chemical used, stored or processed at the facility. Exceptions are for very common materials, such as gasoline, diesel, acetone, etc.

Business name: ______________________________

Permit number: ______________________________

Completeness review completed.
Application determined to be: Complete: ☐ Incomplete: ☐

Permit Engineer: ______________________________ Date: ______________